

THE ANATOMY OF AN AUSTRALIAN LEECH, HELOBDELLA BANCROFTI.

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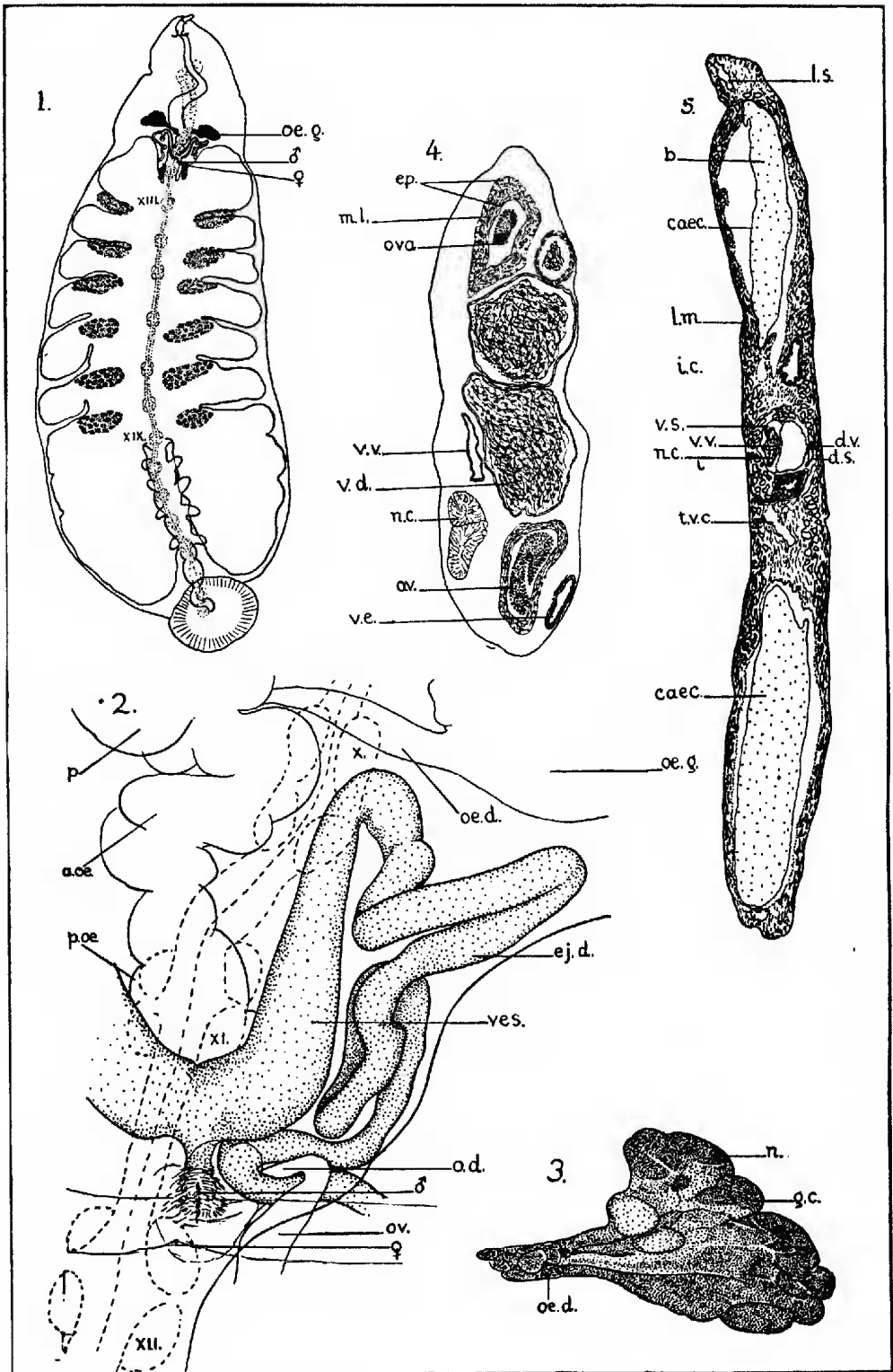
The material studied consisted of three specimens collected by Dr. T. L. Bancroft, and presented to Professor T. Harvey Johnston, by whose kindness I was enabled to examine it. Two individuals were in the form of whole mounts, and the third has been prepared as a series of transverse sections. The leeches were obtained from a turtle, *Emydura krefftii*, in the Burnett River, Queensland, but no information is available as to their colour and markings in life. The crops of all three specimens were distended with blood.

This species of *Helobdella* is small, measuring only 6.8 mm. in length and 2.6 mm. in greatest width, and is greatly flattened dorso-ventrally. The leaf-like general form is shown in fig. 1. The mouth is sub-terminal, lying on the second annulus, and the anterior sucker is inconspicuous. The posterior sucker is circular, with a diameter of 1 mm. and is distinctly marked off from the body. The anus opens in the centre of its disc. A pair of eyes is conspicuous at the anterior end of the body, but no segmental sense organs could be recognised. The genital apertures are situated immediately in advance of ganglion 12, and are separated by a single annulus.

Annulation was not obvious in the preparations as mounted, so that internal structures are referred for their position to the nerve ganglion rather than to the superficial marks of segmentation unless the contrary is definitely stated.

The general form of the body wall shows a certain amount of variation in different regions. This is due to the variable proportions of muscular, glandular, and other elements present, rather than to any alteration in the structures composing it. A typical section is shown in fig. 7. The cells of the epidermis are very irregular in shape, approaching a columnar form only at the extremities of the body and in the neighbourhood of the genital apertures. A very large number of epidermal cells are highly granular and modified as unicellular glands. Some of these may be sunk two or three times the depth of the epidermis below the surface, in which case their secretion is poured out through a narrow duct-like prolongation. The epidermis rests on a layer of fibrous connective tissue, the cells of which have particularly deeply-staining, compact, spindle-shaped nuclei. There is no sign of the definite arrangement of longitudinal, circular, and dorso-ventral muscle layers which characterises the more highly organised leeches. Most of the muscle fibres, except those which run in the incomplete septa dividing the somites, are longitudinal. They form irregular masses beneath the epidermis and are almost lacking at the margins of the body (fig. 5). Lying amongst the muscle fibres and scattered in the connective tissue are a number of very irregular, large, pigment cells containing a highly refractive, granular substance. Minute capillary vessels of the coelomic system form an intricate network among the superficial layers of the body wall, and the larger collecting sinuses with which these ultimately communicate, lie in the deeper layers.

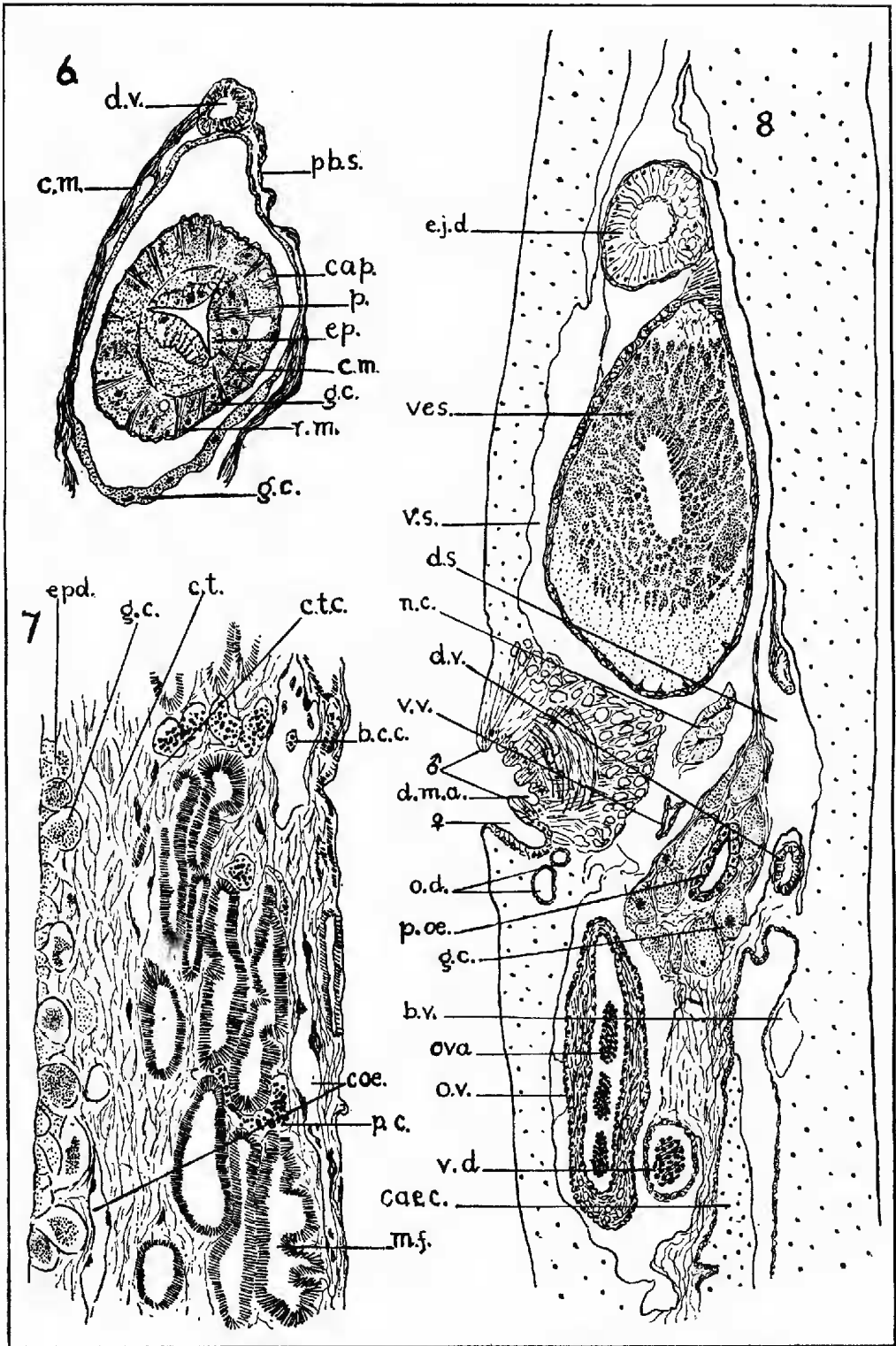
The main coelomic spaces are four in number, dorsal, ventral, and lateral. The largest is the ventral sinus (fig. 4, 5, 8), in which lie the nerve cord, ventral blood vessel, and the various ducts of the reproductive systems, as well as portions of the alimentary canal, and into which the ciliate funnels of the nephridia open. For the greater part of the body length this space assumes almost the dimensions



and relationships of an ordinary coelomic cavity. At both extremities of the body the ventral sinus narrows considerably and is lost among the network of fine cavities connecting it with the dorsal and lateral sinuses. The dorsal sinus is much smaller and would be indistinguishable from the larger of the subcutaneous sinuses if it were not for the presence of the thick-walled dorsal vessel within it. It is connected at both ends with the ventral and lateral sinuses by the network of capillaries already mentioned. The lateral sinuses run very close to the margin of the worm, and the body wall above them is composed of the epidermis and a loose parenchyma, but no muscle fibres. These sinuses are dilated somewhat in each segment and give off metamericly-arranged branches (the transverse coelomic spaces) to the ventral sinus. They also receive numerous branches from the subcutaneous system of spaces whose arrangement has already been described in the account of the body wall. Except in the large size of the ventral sinus this arrangement of sinuses closely follows that described by Bourne in *Glossiphonia (ulepsine)*. All these coelomic spaces are lined by an epithelium of large, squamous cells whose nuclei project into the lumen of the sinus. The coelomic corpuscles are small, usually rounded and often binucleate (fig. 7).

Closely connected with the sinus system are the so-called blood vessels. There are two main trunks, dorsal and ventral, lying in the corresponding sinuses and connected at both ends by a series of capillaries indistinguishable from those of the sinus system. The dorsal vessel is strongly muscular and lies immediately above the alimentary canal (fig. 5, 6, 8). The ventral vessel is larger, thin-walled, and lies just above, and usually close to, the nerve cord.

The alimentary canal has the same general arrangement as is present in other members of the genus. There are a retractile proboscis, an oesophagus, a crop with seven pairs of diverticula, and an intestine. The proboscis sheath is lined by a layer of squamous cells continuous with those of the epidermis and, like them, often granular, showing their glandular function (fig. 6). Outside this is a layer of loose muscular tissue whose fibres are more or less circular, and in which the thick-walled dorsal blood vessel is present. This, in turn, is surrounded by the ventral coelomic sinus. The lumen of the proboscis is trifold in transverse section, and is lined by an irregular columnar epithelium. The muscles of the proboscis consist of a very thin sheet of circular fibres and a number of radial fibres with which are interspersed groups of granular secreting cells. In a whole preparation these radial fibres and the gland cells are seen to be quite regularly arranged, giving the peculiar appearance shown in fig. 15. The epithelium surrounding these structures is squamous, like that of the sheath. A very fine cuticle was observed in places, lining the lumen of the proboscis and of the sheath, and covering the former. Towards the base of the organ the structure of its wall becomes rather looser, and the gland cells stain more deeply with eosin. At the base of the proboscis a thin-walled portion of the alimentary canal receives the ducts of the oesophageal glands, and may be termed the anterior region of the oesophagus. This forms loose coils when the proboscis is retracted, but is probably drawn taut by its extension. The posterior region of the oesophagus is lined by a columnar epithelium, similar to that of the anterior part and surrounded by large glandular cells with peculiar and very obvious nuclei (fig. 8). The stomach or crop follows upon the oesophagus in somite 12 and with its diverticula occupies the greater part of the body from somite 11 to the base of the posterior sucker. The form of these structures may be seen in fig. 1. The stomach passes into the intestine at somite 19. The latter is lined by a glandular, columnar epithelium and bears four segmentally arranged caeca whose epithelium is of a similar type. At somite 24, the intestine opens by a sphincter into the anterior swollen portion of the thin-walled hind gut. The narrow rectum opens by the anus in the centre of the posterior sucker.

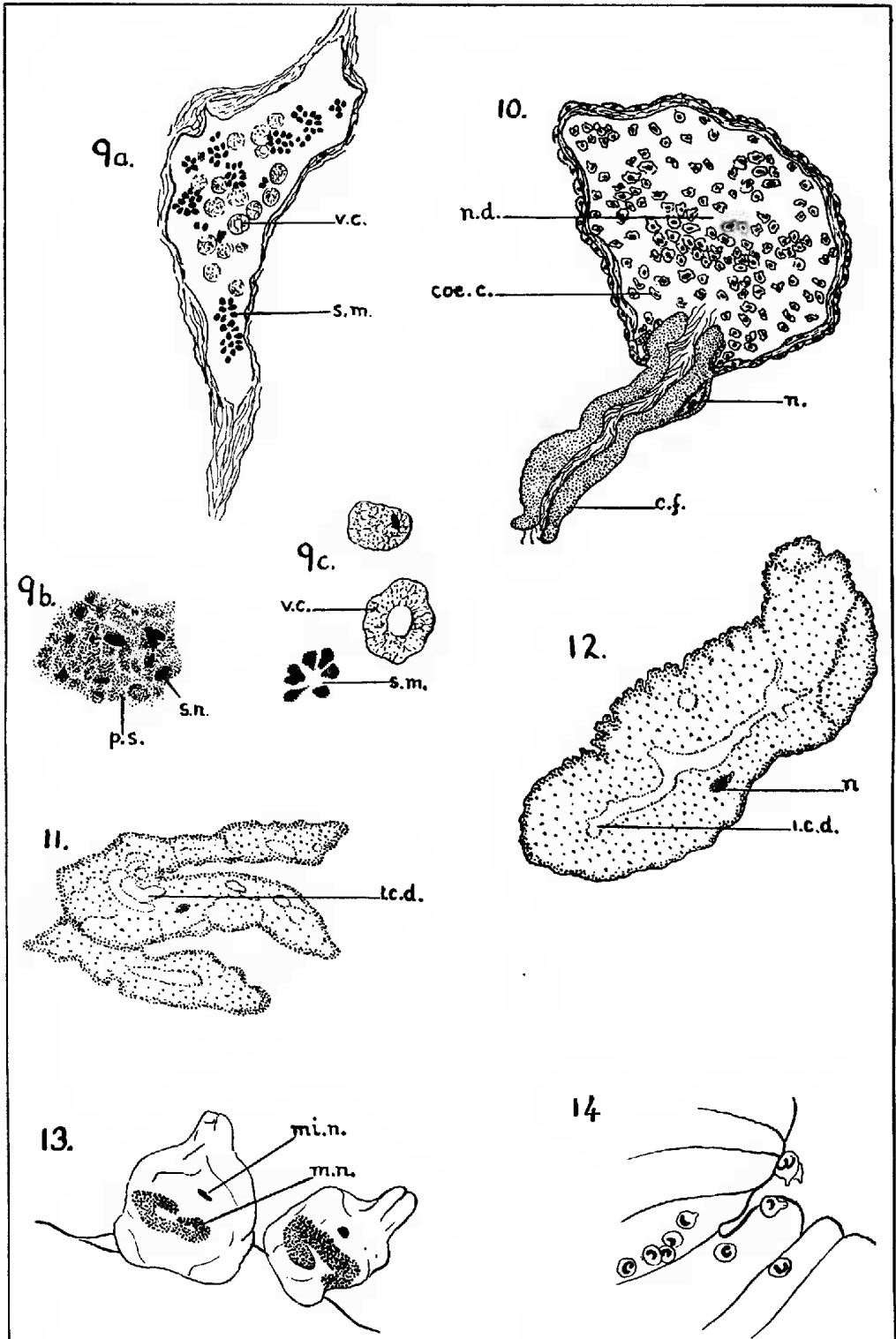


The oesophageal glands are a pair of conspicuous, compact, triangular organs lying in somites 8 and 9. The cells composing them are large, with densely granular protoplasm which stains deeply with eosin. The nuclei are rather small and are situated against the outer boundary of the organ. The cells are pyriform and their tapered ends unite to form the duct of the gland, so that the constituent cells retain their individual connection with the oesophagus in spite of the compact nature of the gland.

There are six pairs of testes, situated between the crop diverticula in somites 13/14 to 18/19. From each testis a thin-walled vas efferens unites with the vas deferens of its own side. This duct passes forward within the ventral sinus and median to the ovary where this is present. Each vas efferens runs side by side with the vas deferens for some distance, eventually joining it at about the level of the preceding testis. In somites 10 and 11, the vas deferens of each side is thrown into coils within the space median to the anterior caeca of the stomach. This coiled ejaculatory duct passes anteriorly into a large club-shaped vesicula seminalis on each side of somite 10. These organs extend posteriorly to the boundary of the annulus containing the male aperture, and are 1 mm. in length and .04 mm. in their greatest diameter. The wall of the vesicula is composed of an outer layer of circular muscle continuous with that of the ejaculatory duct and an inner zone of very large cells, clear towards their outer extremities and very granular towards the lumen of the organ. At the narrow anterior end these cells merge into the clear, tall columnar epithelium of the ejaculatory region of the vas. The nuclei of the secreting cells are small and close to the muscular coat. The lumen of the vesicula is irregular, the tapered distal portion of each secreting cell projecting into it in the form of a minute papilla (fig. 8). This arrangement is doubtless connected with the formation of spermatophores within the organ. The two vesiculae seminales unite near the midline, below the ventral nerve cord, to form a short muscular common duct opening at the male aperture. Below this duct is a small blindly-ending depression lined with columnar epidermal cells similar to those covering the immediate neighbourhood of the genital apertures, and opening at the male pore. In the sectioned specimen male activity was apparently nearly past. The testicular sacs contained only a few scattered sperm morulae and a number of large cells with a reticular or highly vacuolate protoplasm. On the other hand, the portions of the male ducts contained within the ventral sinus, both vas deferens and vasa efferentia, were swollen with masses of sperms embedded in some sort of prostate secretion. The histological form of these various cells is shown in fig. 9a, b, c.

The ovisacs apparently vary considerably in size according to the sexual condition of the individual. In one specimen examined as a whole mount they extended very little behind the ganglion of somite 12, whereas in the material sectioned they reached somite 16 posteriorly and showed, in addition, an anterior caecum which extended into somite 10. The structure of the wall of the ovisac varies little in its entire length. Both within and without there is a squamous epithelium which may be thrown into small folds. The main thickness of the tube consists of a layer of very small muscle fibres in a connective tissue matrix. In the neighbourhood of the genital pores these and the fibres of the common male duct approach those of the body wall in size and become indistinguishable from them.

Nephridia are absent from the part of the body anterior to the genital apertures and from the posterior sucker. The nephridial funnel is connected with the ventral sinus and the nephridiopores open ventrally in the median third of the body. The coils of the nephridia extend to the margin of the body just inwardly from the lateral sinus. The ciliate funnel (fig. 10) is long and narrow and lined with very long cilia. Its extremity is bifid, each lobe being further partly sub-



divided into two, and each of these four divisions bears a nucleus. Another nucleus is present at the base of the structure. The funnel projects a little into the dilatation following upon it, and here two smaller nuclei are present. This dilatation takes the form of a large sac whose walls are formed of a single layer of cells surrounding a fibrous capsule. Its lumen is filled with coelomic corpuscles. The tubules of the nephridium extend outward to the margin of the body and then return to open by the nephridiopore just ventral to the ciliate funnel and a little behind it. Typical cells of this nephridial tissue, with their intracellular ducts, are shown in figs. 11, 12. The ciliate funnels lie just in advance of the ganglion in the somite which contains them. In all these respects the nephridia resemble those of other members of the same family fairly closely.

The central nervous system has the general character described in detail by Hemmingway for *Placobdella pediculata*. The highly organised eyes lie well beneath the surface on the third annulus. Each consists of a cup-shaped mass of pigment of the same type as that contained in the ordinary pigment cells of the body wall, which are in this region very numerous (figs. 17, 18). The cup is filled with clear cells of the usual type, but no axial fibres were observed. The front of the cup is filled by a mass of cells reaching the surface of the body at one point and extending slightly beyond the limits of the pigment layer. The nuclei of these cells are seen in section to be situated round the periphery of the mass which is enclosed in a distinct capsule. The protoplasm of these rod-like cells is finely granular. They are homologous with the "tactile cells" described by Whitman, but appear to be more specialised as an optical medium than any studied by him, judging from Miss Merrill's summary of his work. In the present species these cells form a distinct, clear cornea-like structure, filling the space between the cells of the optic cup and the surface. The nuclei of these "tactile cells" differ from those of similar cells of the marginal sense organs in the more open nature of their chromatin network.

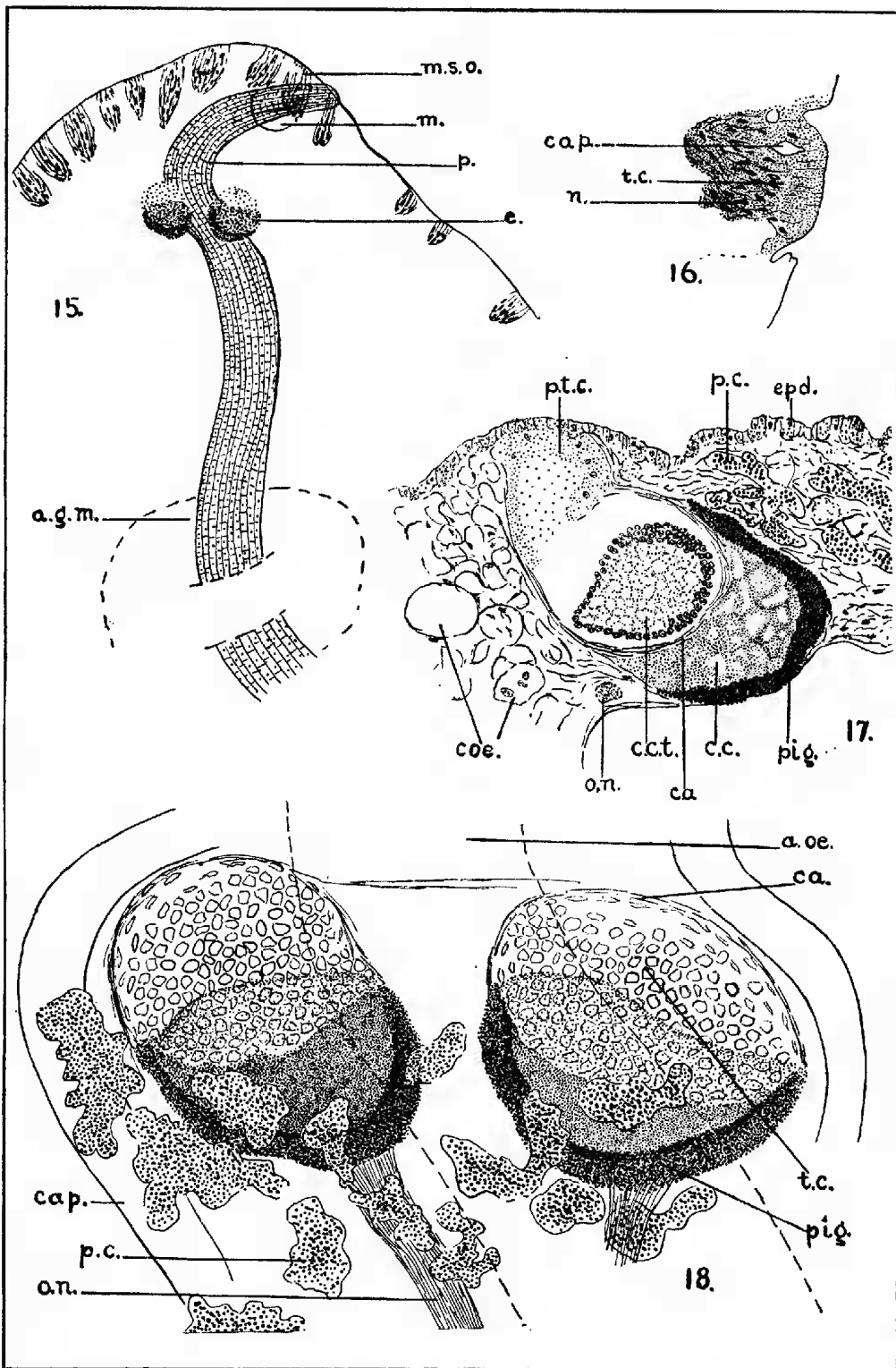
Segmental sense organs or sensillae of the usual type were not observed, but the anterior margin of the body is bordered by marginal sense organs. These take the form of groups of rod-like sensory or tactile cells whose protoplasm is densely packed with fine granules and whose nuclei are spindle-shaped. Capillary vessels occur among the sensory cells.

Attached to one of the specimens were many solitary, peritrichous ciliates, collected along the edges of any depression on the surface. Their form is shown in figs. 13, 14.

The new species of leech has all the characters of the genus *Helobdella* R. Blanchard, 1896 (Glossiphoniidae), and the name *H. bancrofti* is proposed for it in recognition of assistance rendered by Dr. T. L. Bancroft. Its most obvious specific characters are the absence of a dorsal scute, the very compact nature of the oesophageal glands, and the small size of the intestinal caeca.

This appears to be the first record of a member of this genus from Australia, though Goddard (1908-9) described several species of the related genus *Glossiphonia*.

The type slide is being deposited in the South Australian Museum.



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| " 3: L.S. Oesophageal gland. | " 12: Cell from median loop of nephridium. |
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All the transverse sections are somewhat oblique.

EXPLANATION OF LETTERING.

a.g.m., anterior ganglionic mass; a.oe., anterior region of oesophagus; b., vertebrate blood in crop; b.c.c., binucleate coelomic corpuscle; b.v., blood vessel; ca., capsule surrounding corneal cells; caec., caecum of crop; cap., capillary; c.c., clear cells; c.c.t., corneal cells, "tactile"; c.f., ciliate funnel; c.m., circular muscle; coe., coelomic space; coe.c., coelomic corpuscle; c.t., connective tissue; c.t.c., connective tissue corpuscle; d., duct; d.m.a., depression below male aperture; d.s., dorsal coelomic sinus; d.v., dorsal vessel; e., eye; e.j.d., ejaculatory duct; ep., epithelium; epd., epidermis; g.c., gland cell; i., intestine; i.c., intestinal caecum; i.c.d., intra-cellular duct; l.m., longitudinal muscle; l.s., lateral coelomic sinus; m., mouth; m.f., muscle fibre; m.n., micronucleus; m.l., muscular layer; m.n., meganucleus; m.s.o., marginal sense organ; n., nucleus; n.c., nerve cord; n.d., nephridial dilatation; o.d., oviduct; oe.d., duct of oesophageal gland; oe.g., oesophageal gland; o.n., optic nerve; ov., ovisac; ova., mass of developing ova in ovisac; p., proboscis; pb.s., proboscis sheath; p.c., pigment cell; pig., pigment cup; p.oe., posterior region of oesophagus; p.s., prostate secretion; p.t.c., prolongation of corneal cells ("tactile") towards surface (cut obliquely); r.m., radial muscle; s.m., sperm morula; s.n., sperm nucleus; t.c., tactile cell; t.v.c., transverse coelomic space; v.c., vacuolate cell; v.d., vas deferens; v.e., vas efferens; vcs., vesicula seminalis; v.s., ventral coelomic sinus; v.v., ventral vessel.

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